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Accelerator Physics Issues in Low Emittance Synchrotron Radiation Sources. S. CHATTOPADHYAY (Lawrence Berkeley Laboratory, University of California, Berkeley)*

A variety of research with bright synchrotron radiation call for charged particle beams of high intensity and low emittance. The combination leads to a high-brightness beam. Such beams of electrons would be of commonplace occurrence in the third generation synchrotron radiation sources. The physics of such beams will be dominated by the intense self-fields, the associated spatio-temporal coherence and the intense radiation they generate due to various fast acceleration mechanisms. These effects manifest not only in the dynamics of a single charged particle and the beam as a whole, but in the generated photons as well. The maintenance of a beam with high brilliance becomes naturally self-limiting due to these various competing and sometimes conflicting processes. Examples of such processes to be considered are various collective instabilities of the beam, beam growth in phase space by enhanced intrabeam Coulomb scattering due to high phase space density, Debye screening effects, beam self-impedance via interaction with self-generated coherent radiation in an enclosed vacuum chamber, nonlinear dynamical effects, etc. A self-consistent, albeit incomplete, understanding of the parameter regimes and scaling of these processes has emerged in the accelerator physics community in the last decade, an understanding which is the crutch and the guiding light for the designers of those unquestionably complicated future generation of accelerators. A survey of this understanding will be the main objective of this talk.

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